

# Health Consultation

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Evaluation of Sampling Data and Health Implications of  
Operable Unit No. 4

RIVERFRONT  
(a/k/a NEW HAVEN PUBLIC WATER SUPPLY SITE)

NEW HAVEN, FRANKLIN COUNTY, MISSOURI

EPA FACILITY ID: MOD981720246

**Prepared by the  
Missouri Department of Health and Senior Services**

DECEMBER 30, 2009

Prepared under a Cooperative Agreement with the  
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Agency for Toxic Substances and Disease Registry  
Division of Health Assessment and Consultation  
Atlanta, Georgia 30333

## **Health Consultation: A Note of Explanation**

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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## HEALTH CONSULTATION

Evaluation of Sampling Data and Health Implications of  
Operable Unit No. 4

RIVEFRONT  
(A/K/A NEW HAVEN PUBLIC WATER SUPPLY SITE)

NEW HAVEN, FRANKLIN COUNTY, MISSOURI

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Prepared By:

Missouri Department of Health and Senior Services  
Division of Community and Public Health  
Section for Disease Control and Environmental Epidemiology  
Bureau of Environmental Epidemiology  
Under Cooperative Agreement with the  
Agency for Toxic Substances and Disease Registry

## ***SUMMARY***

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<b>INTRODUCTION</b>	A top priority for the Missouri Department of Health and Senior Services (DHSS), in cooperation with the federal Agency for Toxic Substances and Disease Registry (ATSDR), in evaluating the sampling data and its public health implications at Operable Unit No. 4 (OU-4) of the Riverfront site is to provide the New Haven community with the best information possible to safeguard their health.
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OU-4 is one of six OUs that have been or are being investigated for tetrachloroethylene (PCE) contamination that was first detected in the New Haven public water supply wells in 1986. New wells were drilled that provided uncontaminated water for the public water system while the investigation into the source(s) of the PCE contamination continued at the different OUs. OU-4 was found to have groundwater and subsurface soil contamination that is in the process of being remediated.

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<b>CONCLUSION</b>	DHSS/ATSDR reached the following conclusion for OU-4.
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Conclusion	DHSS concludes that the residents in the vicinity of OU-4 and the New Haven community are not being exposed to the PCE contamination at the OU-4 site through drinking the groundwater and breathing vapors or contacting the subsurface soil.
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Basis for Decision	The residents of New Haven are supplied with an uncontaminated public water supply that is not affected by the contaminated groundwater and contamination plume leaving the OU-4 site. Contaminated subsurface soil is not accessible unless activities are taken to dig deep into the subsurface soil, such as buried utilities, etc. Therefore, they are not likely to be exposed.
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Next Steps	The Environmental Protection Agency should continue their remediation of the PCE contamination in the OU-4 area to eliminate the source area and any possible future exposure that might occur.
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## **STATEMENT OF ISSUES AND BACKGROUND**

### **Statement of Issues**

The Missouri Department of Health and Senior Services (DHSS), in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR) has prepared this health consultation to evaluate the possible exposure and health hazards from volatile organic compounds (VOCs) present in Operable Unit 4 of the Riverfront site. DHSS staff reviewed analytical sample results of the soil, groundwater, surface streams, seeps, sewer, indoor and outdoor air present in OU4 to determine if the primary chemical of concern, tetrachloroethylene (PCE), posed a completed exposure pathway and potential health effects. The degradation products of PCE (trichloroethylene (TCE), cis-1,2-dichloroethene (cis-DCE), and vinyl chloride (VC)), as well as other possible contaminants were also evaluated.

### **Background**

The Riverfront Superfund site is located in New Haven, Franklin County, Missouri, a small town on the southern bank of the Missouri River, approximately 50 miles west of St. Louis, on Missouri Highway 100 (See Figure 1). PCE contamination was first detected in one of the original two city wells in 1986 above the Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL) of five parts per billion (ppb). The MCL is the highest level of a contaminant that EPA allows in public drinking water. Continued sampling confirmed the presence of PCE contamination in both of the two public wells, which were eventually shut down as new uncontaminated wells were put into service to replace them. These two new wells are the only source of public drinking water for the more than 1,800 residents of New Haven. Because of the groundwater contamination, EPA proposed the site for its National Priorities List (NPL) on July 27, 2000 and officially listed the site on December 01, 2000 (1,2).

Previous investigations into the source(s) of the PCE contamination and its possible degradation products found multiple source areas that could have contaminated the city wells. Because of the multiple potential source areas, the Riverfront site was divided into six Operable Units (OUs) for further individual investigations (See Figure 2 and 3). For more information on the six Operable Units, see the April 8, 2004 ATSDR Riverfront (a/k/a New Haven Public Water Supply Site) Public Health Assessment, New Haven, Franklin County, Missouri (2).

The Riverfront Operable Unit No.4 (OU4) site is one of the six Operable Units. During the initial phases of the investigation, OU4 consisted of the area east of Miller Street and north of State Highway 100 to Orchard Street that included timber and open fields (See Figure 2). As the investigation into the source(s) of the PCE contamination continued, some areas were eliminated, and new areas were found as possible sources of contamination. Since elevated levels of PCE contamination were found slightly south of Maiden Lane, the OU4 boundaries were moved to

include that area and to encompass a plume of PCE contaminated groundwater that extends from that source area on Maiden Lane north to the Missouri River (See Figure 3 and 4). Currently, the new OU4 area consists of 192 acres and is generally bordered on the west by Maupin Avenue and on the south by Circle Drive, and extends east of Miller Street into undeveloped land, and north to the railroads tracks. Figure 3 also shows an additional operable unit (OU6) that was added to the Riverfront investigation because of a plume of PCE contaminated groundwater that was found leaving OU2 and moving south toward Boeuf Creek (1).

The OU4 investigation into the source of PCE that had contaminated the city wells included, sampling of soil, surface water, groundwater, and tree cores. Through this sampling, it was determined the most likely source of contamination was on Maiden Lane. Previous interviews with area residents indicated that a former employee of both the OU1 and OU2 facilities (both facilities used PCE for degreasing) had brought home some sort of liquid and used it to clean drains at the residence. The major area of contamination was found southwest of an old garage behind the residence where a gray-water line drained into a shallow ditch (1).

A discussion of the different environmental media (soil, water, etc.) sampled and the various levels of contamination present in that media at the OU4 site is presented below. Because levels and detections of cis-DCE and VC were negligible and because EPA remedial actions at the site are anticipated to reduce them more, they will not be further discussed.

## **Soil**

Soil samples taken from the area of expected highest concentration indicated that PCE levels near the surface were low, but increased greatly with depth (1). This is expected since PCE is heavier than water and can easily travel through soil and into groundwater. It evaporates easily in air, but stays in soil and groundwater without much degradation (2). Table 1 gives the maximum soil sampling results for PCE and TCE found at different depths at the Maiden Lane site. Soil samples away from the source area on Maiden Lane found no PCE or other contamination (See Figure 5).

**Table 1**

Soil Sample Results of PCE and TCE at Different Depths at the Source Area  
On Maiden Lane, Operable Unit 4, Riverfront Site, New Haven, MO.  
Sampled November 7 and 8, 2005

Depth in Feet Below Surface	Maximum Concentrations of Chemical in Soil in parts per million (ppm)			
	Laboratory Results		Field Scan Results	
	PCE	TCE	PCE	TCE
0.5 – 1.0	1.50	0.13	1.67	0.25
4.0 – 4.0	n/a	n/a	300.	5.24
5.8 – 6.3	670.	<30.	778.60	4.27
8.0 – 8.0	n/a	n/a	3,200.	14.42
12.0 – 12.0	n/a	n/a	3,600.	15.52
16.0 – 16.0	n/a	n/a	8,000.	42.80
17.2 – 18.0	6,100.	<21.	n/a	n/a
19.0 – 19.0	n/a	n/a	4,400.	7.20

n/a = not analyzed

< = less than

**Source:** US Environmental Protection Agency. Focused Remedial Investigation of Operable Unit 4, Riverfront Superfund Site: Franklin County, Missouri – 2000 to 2007. Final Draft. 2008 July.

## Groundwater

Groundwater sampling has taken place since 1986 when the PCE contamination was first discovered in New Haven Public Wells. As the investigation into the source of the contamination progressed, monitoring wells were added to identify the source area(s) and the extent of contamination. Temporary monitoring wells placed at the Maiden Lane source area in 2007 found PCE levels in perched groundwater above the bedrock exceeding 70,000 parts per billion (ppb) in laboratory analyses. Perched groundwater is an isolated pocket of groundwater. Since Maiden Lane is on a geographic high, groundwater flows to the north toward the Missouri River. PCE levels in this groundwater plume decreases until it is less than 30 ppb near the Missouri River. The plume is expected to be more than 3,800 feet long and nearly 3,000 feet wide near the Missouri River. The plume area includes former city wells #1 and #2 that were removed from service (See Figure 4) (1).

New Haven residences are supplied public water from uncontaminated city wells and are not currently exposed to the soil and groundwater contamination. If well drilling was necessary, OU4 is in the Missouri Department of Natural Resources (MDNR) “Special Area 3” that requires special well drilling permits, techniques, and construction (3). No water well drilling is expected in OU4 since public water is available, especially around the source area on Maiden Lane.

## **Surface Water**

An intensive investigation and sampling of surface water was conducted in the OU4 area, including springs, seeps, streams, and the Missouri River. Only one spring and one seep had PCE levels above EPA's MCL. The level of PCE detected in surface water from Bates Spring that is located between Miller Street and Maupin Avenue was 5.4 ppb, just above the MCL for drinking water of 5 ppb. Levels quickly decreased to less than 1 ppb within 50 feet downstream. Flow from the spring is expected to be less than 0.2 liters per minute. The other surface water sample was taken from a small seep on the east side of OU4 that flows at 0.1 to 0.2 liters of water per minute. This seep had PCE at a maximum level of 30.3 ppb, but decreased to less than the MCL (5 ppb) within 600 feet downstream. PCE was not detected in the Missouri River (1).

## **Outdoor Air**

At the OU4 site, two outdoor air samples were taken, one in 2002 and the other in 2004. The outdoor air sample taken in 2002, approximately 700 feet from the area of major contamination (garage) measured 0.13 microgram per cubic meter ( $\mu\text{g}/\text{m}^3$ ) PCE. The outdoor air sample taken in 2004 measured 0.47  $\mu\text{g}/\text{m}^3$  of PCE and was taken approximately 300 feet from the garage. This 2004 air sample also detected TCE at 1.5  $\mu\text{g}/\text{m}^3$  and toluene at 65  $\mu\text{g}/\text{m}^3$ . Because of the widespread use of PCE and other VOCs in a variety of consumer products and industrial materials, and because of the sensitivity of the analytical method, the detection of small amounts of PCE and other VOCs concentrations is expected (1).

## **Indoor Air**

A total of 21 indoor air samples were collected in 2002 and 2004 at four residences and the New Haven Elementary School in the vicinity of Maiden Lane. These samples were to determine if vapor intrusion of PCE was a problem. EPA established a conservative indoor-air screening level for PCE concentration of 3.0  $\mu\text{g}/\text{m}^3$  as a level of concern. Only the sample taken from the basement of the residence next door to the source area property exceeded the screening concentration at 6.2  $\mu\text{g}/\text{m}^3$ . Samples taken upstairs in the same residence contained PCE at less than 1.0  $\mu\text{g}/\text{m}^3$  (1).

## **Sewer Samples**

In the past, Kellwood/Metalcraft (located in OU2) disposed of waste PCE from their degreasing activities on surface soils and in the sanitary sewer. Sampling of the sewer system throughout New Haven found PCE ranging from 0.1 (estimated concentration) to more than 20 ppb, and generally decreased as the distance from OU2 increased. Only trace concentrations (less than 1 ppb) of PCE were detected in the sanitary sewer that runs through OU4. This is not expected to be a contributing factor to the PCE contamination in OU4 (1).



## **Other Areas of Investigation**

During interviews with local residents to determine possible sources of PCE contamination, three areas of possible dumping of waste were reported. The investigation of these three sites found PCE to be either non-detect or at low levels in the media sampled (soil, surface water, or groundwater). These sites were either ruled out as a PCE source area or determined not to be a substantial source of PCE and probably not associated with the PCE contamination in city wells #1 and #2 (1).

## **Time-Critical Removal Action**

To eliminate the high levels of PCE contamination found in soils and perched groundwater at the Maiden Lane source area, EPA initiated a time-critical removal action to treat the PCE and other VOCs by chemical oxidation. The removal action consisted of two phases of injecting sodium permanganate directly into the contaminated soil and perched groundwater. The oxidant mixes with the harmful chemicals and breaks them down into water and harmless chemicals. The first phase was done in May 2007 in an area primarily southwest and adjacent to the old garage. The second phase was done in October 2007 in an area east and northeast of the old garage (See Figure 6). Approximately 4,200 gallons of sodium permanganate was injected into 120 injection points at the target depth.

At the time of the writing of this health consultation, no data have been received to determine the success of the oxidation of the PCE and other VOCs. To follow up on the remediation of the contamination on Maiden Lane, EPA has developed a proposed plan with a preferred alternative to do soil and groundwater monitoring and additional chemical oxidation treatment if required. The proposed plan also includes institutional controls to reduce exposure to contaminated soils and/or groundwater at OU4 through zoning, ordinances, and public education (4).

## **DISCUSSION**

This section addresses the pathways by which residents, visitors, and workers at the source area on Maiden lane or other areas of OU4 may be exposed to PCE and its degradation products. When a chemical is released into the environment, the release does not always lead to exposure. Exposure only occurs when a chemical comes into contact and enters the body. For a chemical to pose a health risk, a completed pathway must exist that includes uptake by humans through inhalation, ingestion, or dermal absorption.

To evaluate health effects, ATSDR has developed Comparison Values (CVs) for contaminants commonly found at hazardous waste sites. The CV is an estimate of daily human exposure to a contaminant below which non-cancer, adverse health effects are unlikely to occur. Levels above a CV do not mean that health effects will occur. Rather, it calls for more investigation into whether health effects may occur. CVs are developed for each route of exposure, such as

ingestion and inhalation, and for the length of exposure, such as acute (less than 14 days), intermediate (15 to 364 days), and chronic (greater than 365 days).

### **Soil Discussion**

Surface soil samples have not shown levels of contamination that would affect human health at OU4. Surface soil samples (0.5 – 1.0 foot) at the source area on Maiden Lane contained 1.5 ppm PCE and 0.13 ppm TCE. This surface soil level of PCE is over 300 times less than ATSDR's CV Reference Dose Media Evaluation Guide (RMEG) for non-carcinogenic exposure of 500 ppm PCE for intermediate exposure for a child. Likewise the level of TCE in surface soil at the source area is over 3,000 times less than ATSDR's CV acute Environmental Media Evaluation Guide (EMEG) for a pica child of 400 ppm TCE. Individuals who exhibit pica behavior have a craving to put non-food items in their mouths or eat non-food items such as dirt, paint chips, etc. Considering the low levels of PCE and TCE present, that time spent in the yard is expected to be intermittent, and residents are not routinely exposed to the soil, PCE and TCE in surface soil in OU4 is not expected to be a health concern.

If exposure were to occur in the future to the highly contaminated deep soils that are present only at the source area in OU4, this exposure would be expected to be short-term. ATSDR's intermediate non-carcinogenic RMEG for PCE for adults is 7,000 ppm in soils. This is greater than the 6,100-ppm detected at the 17-foot depth, so no non-carcinogenic health effects are expected. If there is construction or utility work in deeper soils, personal protection equipment (PPE) would help eliminate exposure.

### **Groundwater Discussion**

Groundwater contamination has been detected above ATSDR's Comparison Value and/or EPA's MCL, especially in perched groundwater at the Maiden Lane source area site. However, exposure to contaminated perched or deep groundwater is not expected to be taking place because the residents of New Haven are on an uncontaminated public water supply. MDNR has also issued a well drilling advisory that includes the OU4 area, which restricts where new wells may be sited and how they must be constructed.

### **Surface Water Discussion**

Surface water samples from Bates Spring and the seep at OU4 have not shown levels of contamination that would affect human health. The maximum level of PCE in surface water was just above its MCL for drinking water, but the level drops quickly to non-detectable a short distance from the source. The spring and seep are not a source of drinking water for the public. Therefore, exposure to contaminants in the spring would be minimal, if any, and is not expected to be a health concern.

## **Outdoor Air Discussion**

Two outdoor air samples were taken for PCE at a distance of 300 feet and 700 feet from the area of major contamination (garage). PCE was detected at low levels ( $0.47 \mu\text{g}/\text{m}^3$  and  $0.13 \mu\text{g}/\text{m}^3$  respectively) in both samples with sensitive testing equipment. ATSDR has developed a chronic (greater than 365 days) non-carcinogenic EMEG of  $300 \mu\text{g}/\text{m}^3$  for PCE in air (5). Also, because PCE evaporates readily in air, the low levels present in surface soils, and its dispersion in ambient air, outdoor air is not considered to be a health concern.

## **Indoor Air (Vapor Intrusion) Discussion**

Samples taken of indoor air in the vicinity of the source area on Maiden Lane and at the more distant elementary school have found only low levels of PCE. The only area that exceeded EPA's screening concentration ( $3.0 \mu\text{g}/\text{m}^3$ ) for PCE was in the basement of the residence ( $6.2 \mu\text{g}/\text{m}^3$ ) next to the source area, while the level upstairs was well below the screening concentration (1). This could be an indication that PCE may be entering the home from the soil or is coming from another source within the home, such as dry cleaning, etc. ATSDR has developed a chronic (greater than 365 days) non-carcinogenic EMEG of  $300 \mu\text{g}/\text{m}^3$  for PCE in air so the detected air levels should not be a health concern (5). Since PCE is considered to be carcinogenic, calculations of the cancer risk were made using conservative exposure numbers. The cancer risk of 3.76 additional cancers in 1,000,000 fell within EPA's target risk range for cancer of one additional cancer in a population of 10,000 to one additional cancer in 1,000,000. However, considering the activity that has taken place in the remediation of the source area, vapor intrusion rates may have changed. Resampling of the indoor air of homes near the source area after the remediation is complete would ensure that the action was successful.

## **Sewer Discussion**

Since only trace concentrations of PCE were present in the sewer system that runs through OU4, exposure is not expected to be a health concern. Access to the sewer system would only be by sewer system employees and for a short period of time, further minimizing any potential exposure.

# **TOXICOLOGICAL EVALUATION**

## **Introduction**

This section will discuss the possible health effects of exposure to site-specific contaminants. Exposure to PCE, the chemical of concern, can be through inhalation, ingestion, and dermal contact. Very little exposure to PCE and even less exposure to TCE is expected to occur at the site because of the absence of exposure pathways. However, the potential exists that if workers

were to dig into the higher level of PCE contamination at the source, they could be exposed. This toxicological evaluation section will discuss the possible adverse health effects from exposure to PCE and TCE contamination for informational purposes.

### **Tetrachloroethylene (PCE)** (also known as perchloroethylene or perc)

PCE is a volatile organic compound (VOC) that evaporates easily in air, but stays in deep soil and groundwater without much degradation. PCE can easily travel through soil and into groundwater and because it is heavier than water it sinks to the bottom of the aquifer. PCE is a synthetic chemical that is widely used for dry cleaning, metal-degreasing, starting material for making other chemicals, and in some consumer products. In air, PCE has a sharp, sweet odor, which most people can begin to smell at around 1,000 parts per billion (ppb) (5).

ATSDR has developed an Environmental Media Evaluation Guide (EMEG) for PCE of 300  $\mu\text{g}/\text{m}^3$  for chronic non-carcinogenic inhalation exposure (greater than 365 days) (5). Sampling of residences in the area of Maiden Lane has shown a maximum of 6.2  $\mu\text{g}/\text{m}^3$  in a basement in 2004.

If exposure to elevated levels of PCE occurs it can cause nervous system effects such as dizziness, headaches, sleepiness, and confusion. Animal studies, conducted with much higher amounts than most people are exposed to, show that PCE can cause liver and kidney damage. The degradation products of PCE are trichloroethylene (TCE), cis-1,2-dichloroethylene, and vinyl chloride. These chemicals will have similar health effects if present (4).

### **Trichloroethylene (TCE)**

TCE is a volatile organic compound (VOC) that is a non-flammable, colorless liquid that evaporates easily in air, but stays in deep soil and groundwater without much degradation. Because it is heavier than water it can easily travel through soil and into the groundwater. TCE is a synthetic chemical that is mainly used for metal degreasing, but is also an ingredient in adhesives, paint removers, typewriter correction fluids, and solvents. In air, TCE has a sweet odor, which most people can begin to smell at around 100,000 ppb (6). At this site, TCE is present as a degradation product of PCE in the environment and at much lower concentrations than the PCE.

If exposure to elevated levels of TCE is occurring, breathing small amounts may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating. This is the only route of exposure to TCE that may be occurring at the site.

### **Cancer**

The American Cancer Society estimates that in the United States, slightly less than half of all men and slightly more than one-third of all women will develop some form of cancer in their

lifetime (7). The potential for PCE to cause cancer from ingestion and inhalation exposure is presently under review by the EPA. PCE is classified by the International Agency for Research on Cancer (IARC) as probably carcinogenic to humans, based on limited human evidence, sufficient evidence in animals and by National Toxicology Program (NTP) as reasonably anticipated to be a carcinogen. The carcinogenicity of PCE has been documented in animals exposed by inhalation or ingestion (5).

The potential for trichloroethylene (TCE) to cause cancer from ingestion and inhalation exposure is also under review by EPA and is classified by the International Agency for Research on Cancer (IARC) as probably carcinogenic to humans (limited human evidence, sufficient evidence in animals) and by National Toxicology Program (NTP) as reasonably anticipated to be a carcinogen. There is scientific uncertainty regarding the cancer potential of PCE and TCE in humans.

### **Children's Health**

ATSDR/DHSS recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination in their environment. Children are at greater risk than adults from certain kinds of exposures to hazardous substances because they drink more water, eat more food, and breathe more air than adults per kilogram of body weight, and they have a larger skin surface in proportion to their body volume. They also play outdoors and are more likely to come in contact with soil than adults. In addition, children may get contaminated dirt on their hands, and they may ingest some of the dirt if they do not properly wash their hands before eating. They are also shorter than adults and thus are more exposed to dust, soil, and vapors because they are closer to the ground. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care.

DHSS and ATSDR evaluated the likelihood for children to be exposed to contaminants detected at the Riverfront OU4 Superfund site. The site is unrestricted and accessible to children of the neighborhood who may spend time on the site and play in the dirt. Sampling of the soil has shown that PCE levels in surface soils are below ATSDR's RMEG for a child. Since the contaminated area is undergoing remediation to lower or eliminate the PCE contamination in the deep soil and groundwater, the minimal possibility of exposure will be lower yet. Children should not have access to the contaminated groundwater, unless it is used for potable water and that activity is very unlikely as previously discussed. If PCE were present in the indoor air of homes at OU4, children would be affected similarly but to a greater extent than adults.

## **CONCLUSIONS**

DHSS/ATSDR reached one conclusion in this health consultation.

DHSS concludes that exposure to the PCE contaminated groundwater and its associated plume along with the contaminated subsurface soil at Operable Unit No. 4 (OU-4) is not expected to be occurring. Activities that dig deep into the subsurface soils at the OU-4 site, such as buried utilities, etc. could expose workers unless personal protection equipment is used.

## **RECOMMENDATIONS**

1. EPA should continue with the remediation of the source area on Maiden Lane and future monitoring of groundwater including further remediation of soils if necessary.
2. Workers that dig in the deep soils at the source area at Maiden Lane should protect themselves from possible exposure to high levels of PCE with personal protection equipment (PPE) until sampling has shown that remediation has eliminated the elevated levels of PCE.
3. Follow-up indoor air sampling should be done on the residences in the vicinity of the source area after the remediation is complete to verify if the clean-up actions have reduced indoor air levels.

## **PUBLIC HEALTH ACTION PLAN**

This Public Health Action Plan (PHAP) for Operable Unit 4 of the Riverfront Site in New Haven, Missouri contains a description of actions to be taken by the Missouri Department of Health and Senior Services (DHSS), the Agency for Toxic Substances and Disease Registry (ATSDR) and other shareholders. The purpose of the PHAP is to ensure that this public health consultation not only identifies public health hazards, but provides an action plan to mitigate and prevent adverse human health effects resulting from past, present, and future exposures to hazard substances at or near the site. Below is a list of commitments of public health actions to be implemented by DHSS, ATSDR, or other stakeholders at the site.

1. DHSS/ATSDR will review additional sampling data from future groundwater and soil monitoring and provide guidance regarding possible health risks.
2. DHSS/ATSDR will coordinate with MDNR/EPA to implement the recommendations in this public health consultation to help prevent future human exposure at OU4 from occurring.

3. DHSS/ATSDR will continue to address community health concerns and questions as they arise and provide necessary community and health professional education.

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## Attachments

Figure 1: Riverfront Superfund Site Location Map

Figure 2: Former Locations of Operable Units (OUs) at Riverfront Site

Figure 3: Updated Locations of Operable Units (OUs) at Riverfront Site

Figure 4: Extent of PCE Contamination in Bedrock Aquifer

Figure 5: PCE Contamination in Soil Borings in the Maiden Lane Area

Figure 6: Soil Samples Location and Chemical Oxidant Injection Areas at Maiden Lane Area

Table 1: PCE Cancer Risk Calculation for Chronic Indoor Inhalation Exposure

## REFERENCES

1. US Environmental Protection Agency. Focused Remedial Investigation of Operable Unit 4, Riverfront Superfund Site: Franklin County, Missouri – 2000 to 2007. Final Draft. 2008 July.
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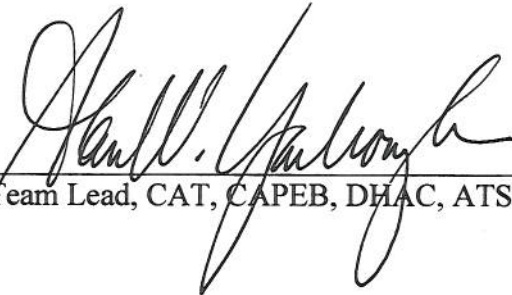
## CERTIFICATION

This Evaluation of Sampling Data and Health Implications of Operable Unit No. 4, Riverfront Site Health Consultation was prepared by the Missouri Department of Health and Senior Services under a cooperative agreement with the federal Agency for Toxic Substances and Disease registry (ATSDR). It was completed in accordance with the approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.



Technical Project Officer, CAT, CAPEB, DHAC

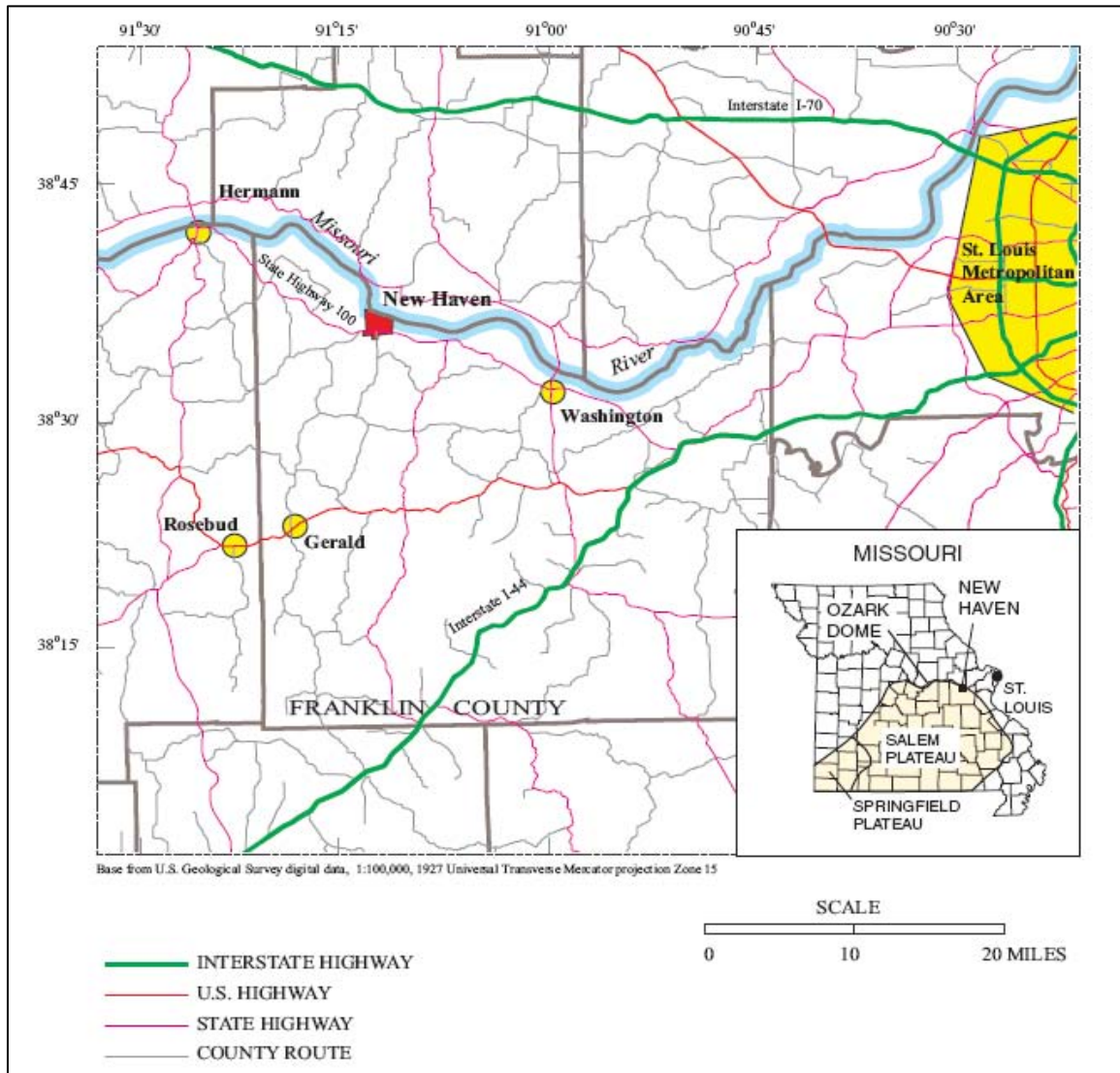
The Division of Health Assessment and Consultation (DHAC), has reviewed the health consultation and concurs with its findings.



Team Lead, CAT, CAPEB, DHAC, ATSDR

**Figure 1**

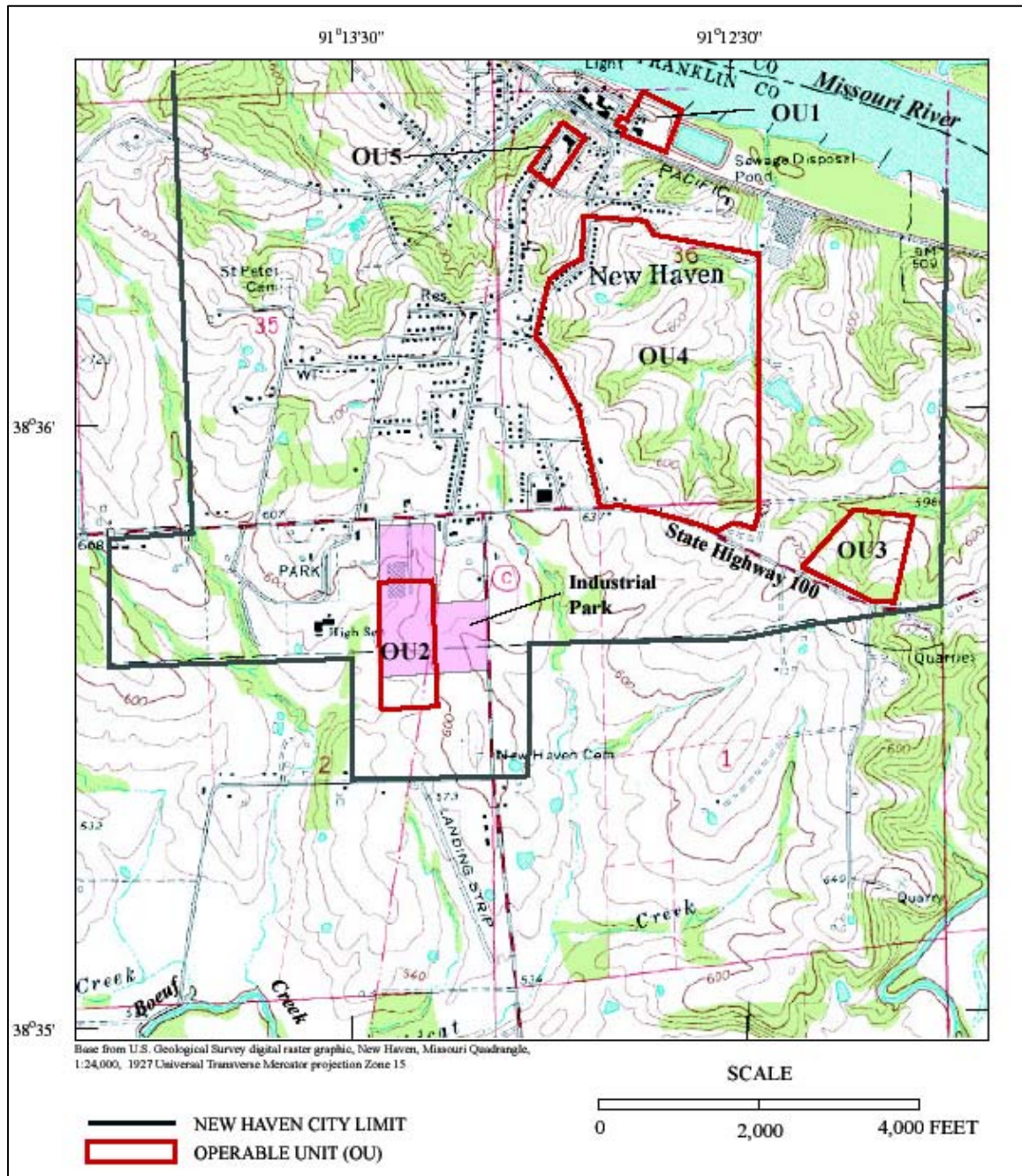
**Riverfront Superfund Site Location Map  
New Haven, Missouri**



**Source:** US Environmental Protection Agency, Final Draft, Focused Remedial Investigation of Operable Unit 4, Riverfront Superfund Site, Franklin County, Missouri. 2008, July.

## Figure 2

### Former Locations of Operable Units (OUs) at Riverfront Site New Haven, Franklin County, Missouri

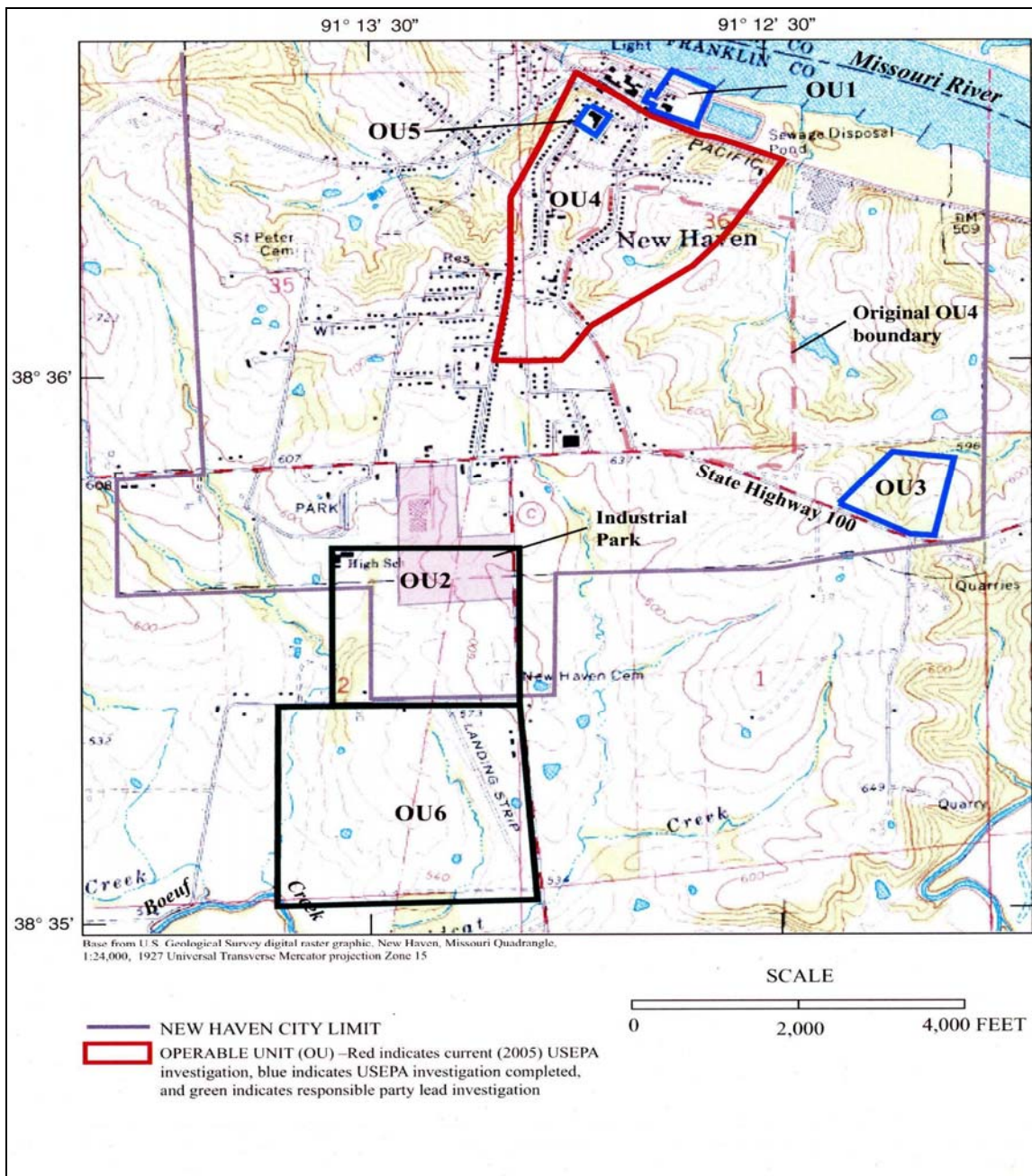


**Source:** U.S. Environmental Protection Agency, Region VII. Focused Remedial Investigation of Operable Units OU1 and OU3, Riverfront Superfund Site, Franklin County, Missouri. 2003.



# Figure 3

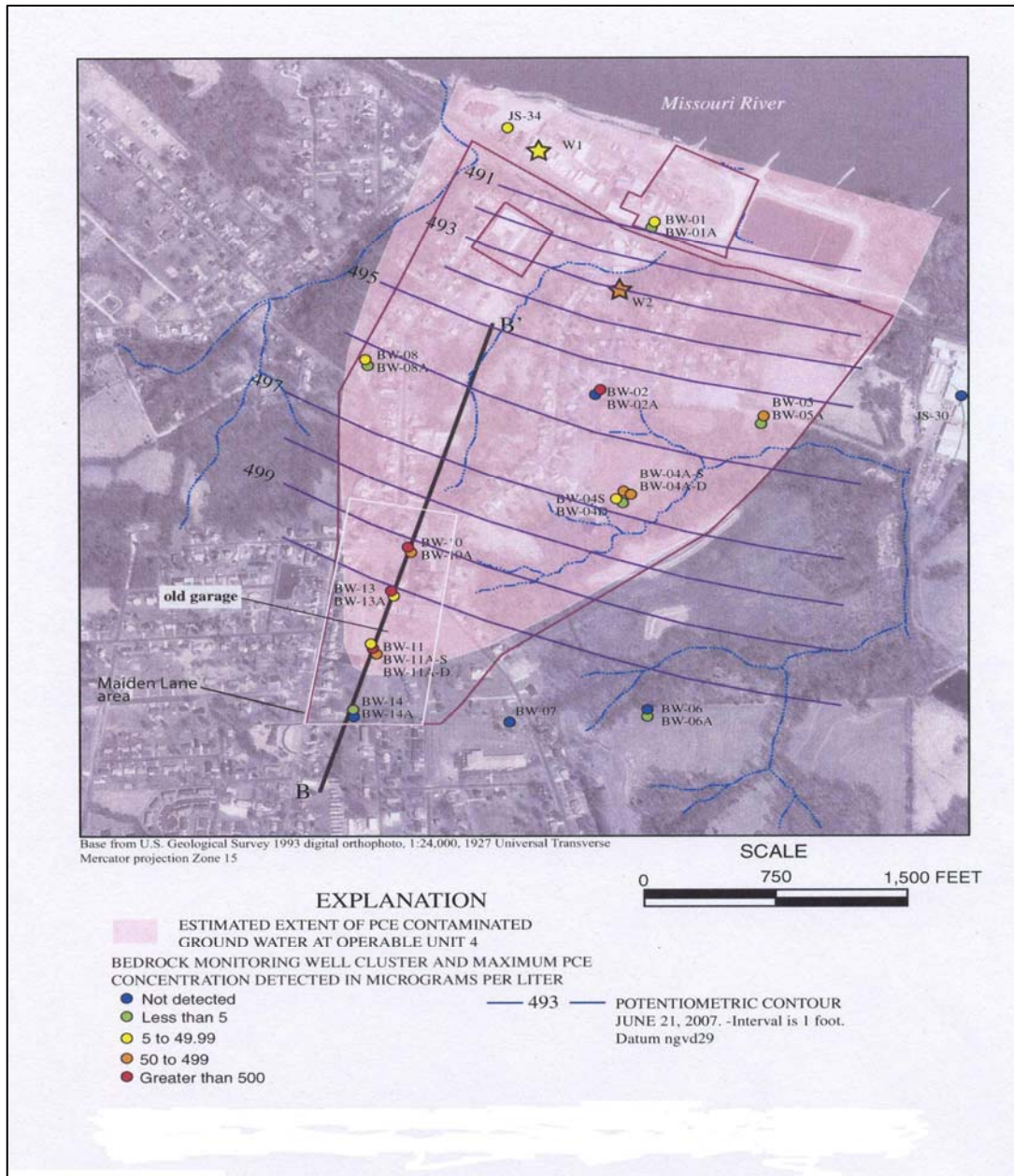
## Updated Locations of Operable Units (OUs) at Riverfront Site New Haven, Franklin County, Missouri



**Source:** US Environmental Protection Agency. Focused Remedial Investigation of Operable Unit 4, Riverfront Superfund Site: Franklin County, Missouri – 2000 to 2007. Final Draft. 2008 July.

# Figure 4

## Extent of PCE Contamination in Bedrock Aquifer in OU4 New Haven, Franklin County, Missouri



**Source:** US Environmental Protection Agency. Focused Remedial Investigation of Operable Unit 4, Riverfront Superfund Site: Franklin County, Missouri – 2000 to 2007. Final Draft. 2008 July.



**Figure 5**

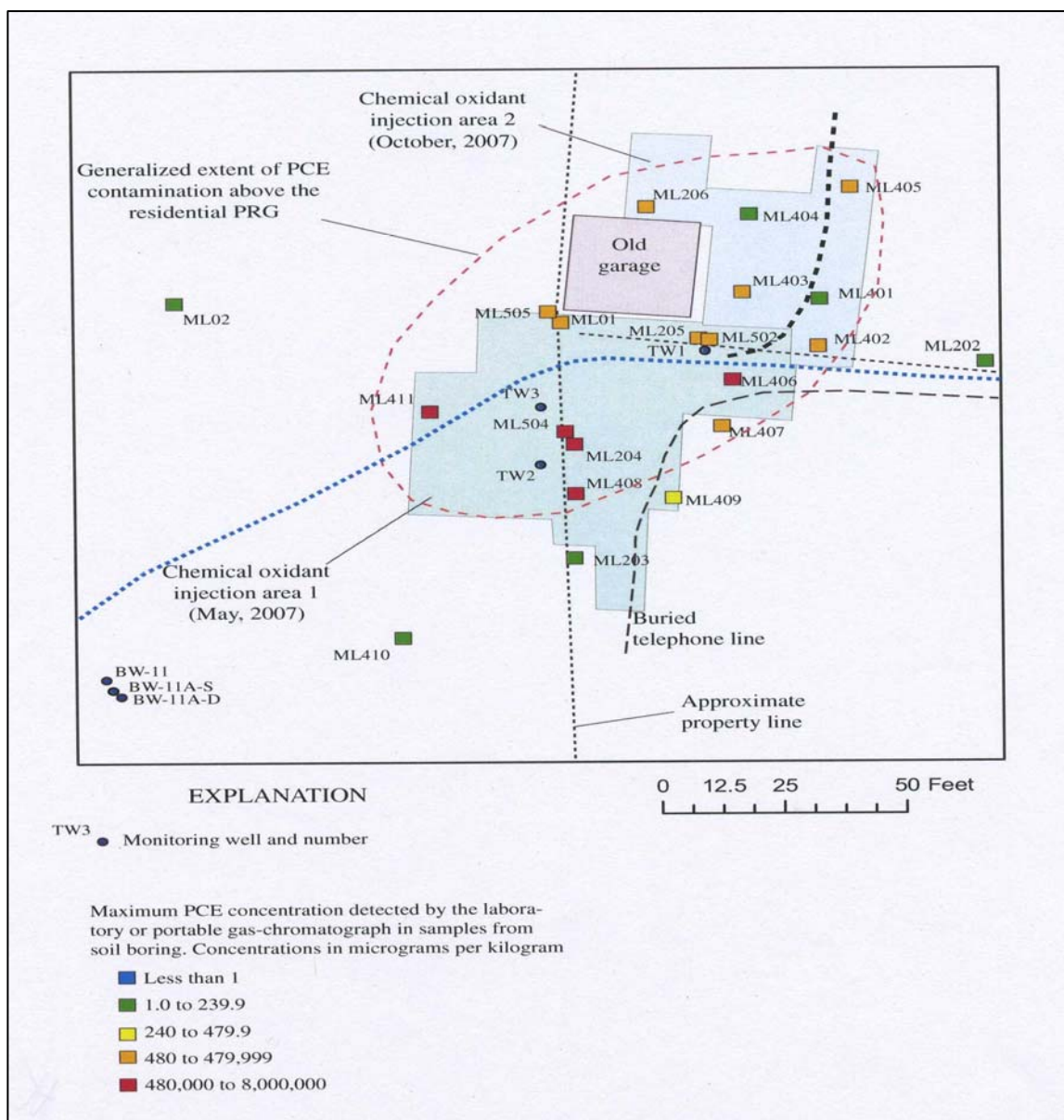
**PCE Contamination in Soil Borings in the Maiden Lane Area  
New Haven, Franklin County, Missouri**



**Source:** US Environmental Protection Agency. Focused Remedial Investigation of Operable Unit 4, Riverfront Superfund Site: Franklin County, Missouri – 2000 to 2007. Final Draft. 2008 July.

## Figure 6

### Soil Samples Location and Chemical Oxidant Injection Areas at Maiden Lane Area New Haven, Franklin County, Missouri



**Source:** US Environmental Protection Agency. Focused Remedial Investigation of Operable Unit 4, Riverfront Superfund Site: Franklin County, Missouri – 2000 to 2007. Final Draft. 2008 July.



## Table 1

### PCE Cancer Risk Calculation for Chronic Inhalation Exposure in Basement of Residence

#### Pathway Intake Equation:

$\text{Intake}_{(\text{Inhalation})} [\mu\text{g}/\text{m}^3] = \text{Air concentration} \times (\text{Exposure time}/24 \text{ hours per day}) \times \text{Days per year} \times \text{Exposure Duration in years}/\text{Lifetime in days}$

$$\text{Intake}_{(\text{Inhalation})} [\mu\text{g}/\text{m}^3] = 6.2 \mu\text{g}/\text{m}^3 \times 6 \text{ hours per day}/24 \text{ hours per day} \times 350 \times 30/25550$$

$$\text{Intake}_{(\text{Inhalation})} [\mu\text{g}/\text{m}^3] = 0.637$$

#### Pathway Risk:

$\text{Total Excess lifetime Cancer Risk} = \text{Intake} \times \text{Inhalation Unit Risk for PCE}$

$$\text{Total Excess lifetime Cancer Risk} = 0.637 \times 5.9\text{E-}06$$

$\text{Total Excess lifetime Cancer Risk} = 3.76\text{E-}06$  or 0.00000376 additional lifetime cancer risk or 3.76 additional cancers in a population of 1,000,000.